

**digital**

## RA Family of Winchester Disk Drives

Mass Storage with Superior Capabilities for Medium and Large Systems



### Leading-edge Data Storage: Large Capacity, High Performance and Reliability, and More

The RA Family of Winchester disk drives for medium and large systems—the RA70, RA82, RA81, and RA60—expand the common criteria of excellence in mass storage. Digital built these drives to maximize storage capacity, performance, and reliability and to minimize disruptions.

RA Family drives are designed with superior large-volume storage capacity. Because of high linear, track, and areal density, they yield ample space for current applications. In addition, they have the ability to expand easily with minimum expense to keep pace with your future needs and protect your investment.

RA Family drives, working in harmony with Digital Storage Architecture (DSA)/Standard Disk Interface (SDI) controllers, give you superior performance and reliability. Because multiple data paths handle simultaneous requests and circumvent I/O bottlenecks, RA drives make data available easily and quickly. Their state-of-the-art error-detection and correction features protect the integrity of stored data.

What's more, these performance-and-reliability-enhancing features are just part of the RA-drive design for optimal availability. RA drives also have modular sub-assemblies for easy maintenance and minimal repairs. And Digital offers attentive service delivery and a one-year, onsite hardware warranty. Taken together, all these features add up to high quality and availability.

## Highlights

- RA disk drives offer the features of the Digital Storage Architecture and the Standard Disk Interface: investment protection, reliable operations with easy maintenance, data integrity and availability, flexibility of configuration, and high levels of performance.
- All RA drives provide one of the most advanced error-correction codes in the industry.
- Data integrity, maximized system uptime, and minimized repair time are the results of RA drive design.
- RA Family design and packaging, low service charge, and easy maintenance add up to low cost of ownership.
- Digital's service offerings—"predictive" maintenance, remote diagnosis, system enhancements, preventive maintenance, educational programs—are broad and flexible to meet your organization's unique service needs.

## Digital Storage Architecture (DSA) and the Standard Disk Interface (SDI)—The Basis for Better Drives and Future Savings

Because RA Family drives incorporate the DSA and use the SDI, they share their special features: high performance, data availability, data integrity, large storage capacity, and investment protection.

DSA is a framework carefully designed to integrate an expanding group of Digital's mass-storage products. This architecture protects your investment in existing and future applications and equipment. DSA includes several families of products, each of which is compatible within itself, but not with other families.

Because RA drives are part of the DSA product set using the SDI, they offer the unique set of SDI features and benefits. The SDI includes the Reed-Solomon Code, one of the most advanced error-correction codes in the industry. It enables RA drives to find and fix as many as 80 bits of error in a single sector. Also, when supported by the host operating system, it can make media defects invisible to applications and file-system software on the host.

SDI is designed with radial connection and dual access to increase the availability of data. In a radial connection, each drive connects directly to its I/O server or controller. It can be plugged or unplugged while that server or con-

troller is running without shutting down the rest of the I/O subsystem—for easy repair, less downtime, and continued availability. Dual access means that RA drives can attach to two controllers to create redundant paths to data. Then, in case one path should fail, data is still available.

RA series drives work in harmony with intelligent SDI I/O servers and controllers to provide optimal I/O subsystem performance. They can run parallel operations and have sophisticated algorithms for seek ordering, bad block replacement (BBR), and revectoring. These features make RA drives ideal for large systems, which have many users and, therefore, heavy demands on the I/O subsystem. RA drives can satisfy I/O demand without sacrificing high performance.

## High Performance through Special Design

Besides maintaining high I/O performance through SDI technology and design, RA drives excel in two other areas of performance: seek times and rotational latency.

For faster seek times the RA70, RA82, and RA81 have dual-positioning systems. Each has two servos in the drive: a dedicated servo for high-speed seeking and an embedded servo for accuracy in conditions of high track density.

Furthermore, all four RA-series drives (working with I/O servers or controllers belonging to the DSA/SDI) minimize rotational latency by allocating the data channel to the on-cylinder drive that has the desired data in the closest position for reading—without causing overhead to the CPU.

#### The RA70 Disk Drive – The Newest Member of the Family

The RA70—the newest addition to the RA Family—is the first 5.25-inch disk drive designed and manufactured by Digital. This 280-megabyte (350-megabytes unformatted\*) disk drive launches a new generation of Digital high-technology disk products. It is the only 5.25-inch fully compatible RA disk drive in the marketplace that has dual access and all of the SDA/DSA functions.

Unlike many 5.25-inch disk drives, the RA70 drive is designed to maximize data availability. In the RA70, the Head Disk Assembly (HDA) is separate from the electronics module. Consequently, if the electronics module fails, it can be replaced without removing the data, which remains available to users. Also, because two Field Replaceable Units (FRUs)—the Module Set and the HDA—make up the RA70, if the drive experiences a problem, the FRU in question can be replaced quickly and efficiently, minimizing MTTR (mean time to repair).



The RA70 disk drive also offers high performance and high density for large data-storage capacity. The RA70 HDA includes a linear actuator with eleven composite data heads and one thin-film servo head. Thin-film media in the RA70 are employed to yield an areal density of 30.4 million bits per square inch. The combination of a dedicated and an embedded servo system provides leading-edge seek performance for high-speed data access.

Because of dual access, the RA70 can utilize all the SDI performance and data availability once offered only in large disks. These features and its 5.25-inch form factor make the RA70 well suited to I/O intensive applications.

With its high availability and performance and ample storage capacity, the RA70 disk drive is designed for I/O-intensive applications. Two or more RA70 disk drives are ideal for fast, frequent access to small blocks of data.

Finally, like all 5.25-inch disk drives, the RA70 receives its power and cooling from its system enclosure.

\* Unformatted capacity provided for comparison purposes only; only formatted capacity is accessible to the user in any disk device.



### The RA82 Disk Drive – The Largest Capacity Drive

The RA82 – a 14-inch, 622-megabyte (855-megabytes unformatted\*), Winchester fixed-media disk drive – is Digital's highest capacity data storage offering high performance, reliability, and data availability, in addition to the benefits of DSA/SDI. These include dual access and complete compatibility with all other RA-series drives, I/O servers, and controllers.

The RA82 disk drive has large storage capacity and high reliability. It is the same disk drive used in SA482 storage arrays for very large system storage and has the same proven reliability. In fact,

as a result of its reliability, the RA82 disk drive also has the lowest service cost of the 14-inch RA disk drives.

It achieves high performance with its dual-positioning system (consisting of an embedded servo and a dedicated servo) for fast seek times and its patented rotary positioner. The RA82 rotary positioner has reduced weight, reduced space and power requirements, and a patented arm with two heads, each covering half the recording surface. This design speeds up average access time.

The RA82 disk drive also uses Winchester technology to provide high performance and high capacity in a compact, rackmountable, fixed-media disk drive.

All of these advantages make the RA82 disk drives ideal for applications requiring high-capacity storage and high transfer rates for large, contiguous files.

### The RA81 Disk Drive

The RA81 is a 14-inch, 456 megabyte (527 megabytes unformatted\*) Winchester disk drive with highly reliable storage capacity. It shares the design, packaging, and architectural features of the RA82, described in the previous section.

### The RA60 Removable-media Disk Drive

The RA60, a 14-inch, removable-media disk drive, employs a 205-megabyte (250-megabyte unformatted\*), removable disk pack. It is an appropriate alternative to fixed-media disk drives, particularly in environments requiring high security and fast, reliable data interchange.

The RA60 is engineered to provide large data-storage capacity. An efficient recording code increases linear density. An innovative adaptation of conventional head design with four air-bearing surfaces gives the RA60 superior aerodynamic stability. Coupled with the highest-quality metal oxide media and a special spin-up purge cycle, these heads permit recording at nearly 8-million bits per square inch.

\*Unformatted capacity provided for comparison purposes only; only formatted capacity is accessible to the user in any disk device.



Several design features contribute to the RA60's high reliability. The RA60's positioner assembly and drive spindle are precision-mounted, eliminating the need for periodic alignment, and the embedded servo eliminates head alignment. As a result, the only preventive maintenance needed is the annual change in the air-supply filter. Furthermore, direct driving of the spindle increases the drive's reliability by eliminating belts and pulleys. The RA60 incorporates an impeller into the motor spindle, instead of using a separate fan to direct air flow during operation, to improve reliability and packaging efficiency.

The RA60 drive has a universal power supply with independent switching for line voltage and frequency. A single model with the appropriate power cord works anywhere in the world.

#### **DECservice Hardware Warranty— Your Year-long Protection**

Digital satisfies customers' demands for reliability and service by delivering reliable disk drives engineered for easy maintenance and by backing them with one-year, onsite DECservice Hardware Warranties and the fast, attentive care of the Digital Field Service Organization.

Throughout the year-long warranty, RA disk drives have the full support of service tools and technology developed for the entire VAX Family with a two-hour response\*\* on the VAX 8000 Series Systems and a four-hour response\*\* on all others.

\*\*Service terms may vary outside the United States. Check with your local Digital Field Service Office for details of the service terms offered in your area.

At the end of the one-year warranty, Digital offers many service packages tailored for different needs. For the same high level of service of the warranty period, you can choose DECservice with committed response times, available 24 hours a day, 7 days a week. For less critical applications, you can choose the Basic Service Agreement.

#### Digital Field Service Features

Senior Digital Field Service engineers are an integral part of product design teams. They ensure that all Digital storage products can detect and isolate faults—to provide the high data availability and integrity that research shows you want from storage products.

They also build in diagnostic capabilities. These can be initiated by the Remote Diagnosis Center (RDC) or by the storage controller—without interrupting the other storage products.

Our service offerings—remote diagnosis, automatic updates, system enhancements, preventive maintenance, educational programs—are broad and flexible enough to meet your organization's unique service needs. And our competitive monthly service charges, combined with the high quality and vast resources of Digital's Field Service Organization, offer a superior value for your service dollar. The one-year warranty reflects the faith we have in the reliability and ease of service engineered into all our storage products.

#### Specifications

	RA70	RA82	RA81	RA60
<b>Performance</b>				
Peak transfer rate	1.40 MB/s	2.40 MB/s	2.20 MB/s	1.98 MB/s
Avg. seek time	19.5 ms	24.0 ms	28.0 ms	42.0 ms
Avg. rotational latency	7.5 ms	8.3 ms	8.3 ms	8.3 ms
Avg. access time	27.0 ms	32.3 ms	36.3 ms	50.3 ms
Nominal start/stop time	59 s/15 s	50 s/20 s	50 s/20 s	60 s/40 s
<b>Media Characteristics</b>				
Formatted capacity:				
16-bit format	280 MB	622 MB	456 MB	205 MB
18-bit format	N/A	N/A	463 MB	208 MB
Unformatted capacity†	350 MB	855 MB	627 MB	250 MB
Tracks (radial)/cm	533.5	418.5	377.9	306.7
Tracks (radial)/in	1355	1063	960	779
Bits (linear)/cm	8833.5	4938.9	4488.2	3806.3
Bits (linear)/in	22,437	12,545	11,400	9,668
Rotational speed	4000 r/min	3600 r/min	3600 r/min	3600 r/min
No. of data surfaces	11	8	7	6
No. of heads/surface	1	2	2	1
Sectors per track:				
16-bit format	34	57	52	42
18-bit format	N/A	N/A	47	38
Bytes per sector:				
16-bit format	512	512	512	512
18-bit format	N/A	N/A	576	576
Logical cylinders	1507	1423	1248	2382
Tracks per logical cylinder	11	15	14	4

**Let Us Help You Find the Answers**  
 Commitment to the mass-storage business requires a significant and continuing investment in equipment and expertise. Digital makes this investment because we understand the importance of delivering complete computing solutions to our customers.

To learn more about the RA disk drives or any other Digital product, please call your nearest Digital sales office. Or if you have specific questions, in the United States call our toll-free information hotline, 1-800-DEC-INFO (1-800-332-4636).

#### Specifications (continued)

	RA70	RA82	RA81	RA60
<b>Power Requirements</b>				
Single phase input power	120 Vac at 60 Hz or 240 Vac at 50 Hz for all four models			
Current at 60 Hz:				
Starting	3.8 A	35.0 A	35.0 A	6.5 A
Running	2.4 A (idle)	7.0 A	7.0 A	3.5 A
Current at 50 Hz:				
Starting	1.9 A	17.7 A	17.7 A	3.25 A
Running	1.2 A	3.5 A	3.5 A	1.75 A
<b>Operational Environment</b>				
Temperature range	10-40°C (50-104°F)	10-40°C (50-104°F)	10-40°C (50-104°F)	16-40°C (60-104°F)
Max. wet bulb temperature	32°C (90°F)	28°C (82°F)	28°C (82°F)	26°C (79°F)
Relative humidity (noncondensing)	10%-80%	10%-85%	10%-85%	8%-80%
Max. altitude	2.4 km (8000 ft) for all four models			
Derating factor for altitude	1.8°C/1000 m (1°F/1000 ft) for all four models			
Heat dissipation (650 watts)	0.18 mJ/h (171 Btu/h)	2.11 mJ/h (2,000 Btu/h)	2.32 mJ/h (2,200 Btu/h)	2.32 mJ/h (2,200 Btu/h)
<b>Physical Characteristics</b>				
Height	9.0 cm (3.5 in)	26.4 cm (10.4 in)	26.7 cm (10.5 in)	26.7 cm (10.5 in)
Width	14.6 cm (5.8 in)	44.5 cm (17.5 in)	44.5 cm (17.5 in)	44.5 cm (17.5 in)
Depth	22.4 cm (8.8 in)	67.3 cm (26.5 in)	71.1 cm (28.0 in)	85.1 cm (33.0 in)
Weight	4.8 kg (10.5 lb)	78.2 kg (172 lb)	61.2 kg (135 lb)	70.5 kg (155 lb)
Disk pack weight	N/A	N/A	N/A	2.85 kg (6.3 lb)

<sup>\*</sup>All performance data reflects raw drive hardware capability and does not include improvements resulting from controller optimizations.

<sup>t</sup>Unformatted capacity is provided for comparison purposes only. Only formatted capacity is accessible to the user in any disk drive.



Digital Equipment Corporation makes no representation that the interconnection of its mass-storage products with products of other manufacturers will not infringe on existing or future patent rights. Nor do the descriptions contained herein imply the granting of licenses to make, use, or sell equipment constructed or configured in accordance herewith.

Digital Storage Architecture (DSA) mass-storage products manufactured by Digital Equipment Corporation are designed to work with host computers and other SDI mass-storage products designed by Digital Equipment Corporation. Digital Equipment Corporation assumes no responsibility or liability if the host computers, controllers, mass-storage servers, tape, software, diagnostic, or disk products of another manufacturer are used with DSA products.

Digital believes the information in this publication is accurate as of its publication date; such information is subject to change without notice. Digital is not responsible for any inadvertent errors.

The following are trademarks of Digital Equipment Corporation: DEC, DECsysteM-10, DECSYSTEM-20, DECUS, DECmate, DECnet, DECwriter, the Digital logo, HSC50, HSC70, KDA50, KDB50, MASSBUS, PDP, P/OS, Professional, Rainbow, RSTS, RSX, SA482, UDA50, UNIBUS, VAX, VAXBI, VMS, and VT.